A Better Lubricant

for P-3 Flap Tracks and Screwjacks

Jacksonville Finds a Solution that Guards Against Corrosion

A local P-3 squadron (VP-30) at Naval Air Depot (NADEP) Jacksonville, Florida was looking for a better way to lubricate the flap tracks and screwjacks in the wings of their aircraft. Karl Martin of the P-3 Fleet Support Team (FST) turned to the Materials Laboratory at Jacksonville and Jack Benfer to validate the use of a new lubricant. Martin, Benfer and their colleagues went the distance to find a new product that exceeded the squadron's expectations and is now being considered for use on other platforms across the Fleet.

Background

In December 2000, Martin received a naval message, initiated by the local P-3 squadron (VP-30) asking for approval to use a different product (manufactured by DSX) to lubricate and protect the flap tracks and screwjacks on their aircraft from corrosion.

Flaps in the aircraft's wings are moved back and down to obtain more lift at lower speeds (during landing) or retracted in flight (to get more speed and less lift). The wing flaps ride on flap tracks via a carriage with roller wheels on the top and bottom of the track. Screwjacks are long threaded rods used to engage and retract aircraft wing flaps.

Each time screwjacks get wet—due to post-flight rinses in "bird baths" and regular monthly aircraft washings—they must be re-lubricated and protected against corrosion. This application regime requires a lot of time on the part of P-3 maintenance personnel and requires the use of a large volume of material. Martin approached Benfer at the NADEP Jacksonville Materials Laboratory for an initial corrosion prevention analysis on DSX lubricants.

The P-3 squadron was particularly interested in finding a suitable substitute that would:

A P-3 aircraft going through a "bird bath."

- Ensure for the proper lubrication of the screwjacks,
- Require less frequent application, and
- Provide sufficient protection against corrosion.

Phase 1: Testing Products for Lubricity & Corrosion Protection

In February 2000, Benfer and his colleagues conducted an analysis of two DSX products using a typical "salt fog" chamber in accordance with the American Society for Testing and Materials (ASTM) Standard B117—Standard Practice for Operating Salt Spray (Fog) Apparatus. (This standard discusses the procedure and conditions required to create and maintain the salt spray (fog) test environment. A salt fog test is performed in an enclosed chamber where a 5 percent sodium chloride (NaCl) solution is sprayed onto test components at 35 degrees Celsius. This test accelerates corrosion representative of maritime or carrier environments.)

The purpose of this salt fog test was to determine the corrosion protection properties of:

- The lubricant that the P-3 squadron was interested in using (a DSX manufactured product),
- The existing product (VV-L-800), and
- MIL-C-81309 (a standard product included in the testing protocol as a corrosion protection benchmark).

Once this analysis from the salt fog tests was complete, Benfer could compare the performance of each product with an untreated coupon (or control sample).

Initial Results

Benfer and his colleagues tested the DSX lubricants (DSX CLT lubricant and Impact lubricant) against the VV-L-800 and issued a report about the corrosion protection properties of each product. As shown in Figure 1, the initial tests determined that neither the DSX products nor VV-L-800 exhibited the corrosion protection properties required by the P-3 squadron (according to MIL-C-81309). The Materials Laboratory report recommended that further testing be conducted to find a better product for the Fleet.

FIGURE 1: Initial tests determined that the DSX products did not meet the corrosion prevention requirements of the P-3 squadron at NADEP Jacksonville.

Going the Distance

Benfer and Martin realized that it was important to go the distance to serve the Fleet. Finding a better lubricant that met the needs of the local P-3 squadron was the ultimate goal. It wasn't enough to stop once the requirements outlined in the original naval message were met.

In the interest of finding a better lubricant, Benfer and Martin reviewed reports outlining a study of twelve lubricant/corrosion protectants at ten sites within the United States prepared for the F-16 aircraft program. Hill Air Force Base (AFB) and Warner Robins AFB sponsored the reports. The program was looking for a material to improve the performance of electrical connectors that may have been contributing to the failure of engines in the F-16 aircraft. Corrosion within a barrel connector resulted in the uncommanded closure of the main fuel shutoff valve to the single F-16 engine.

According to the Hill AFB report, the new product performed very well on the gold–plated, electrical connectors. A high degree of corrosion inhibition was also demonstrated for carbon steel sensor surfaces. The new product selected to treat the connectors is called Lektro-Tech Super Corr-B manufactured by Lektro-Tech, Inc. of Tampa, Florida.

SUPER CORR: THE BASICS

- **Product Name:** Lektro-Tech Super Corr-B
- **Mil-Spec:** Mil-L-87177A
- **Manufacturer:** Lektro-Tech, Inc. of Tampa, Florida
- **Product Description:** An anti-corrosive water displacing film
- **Product Attributes:** Type I, Grade B Corrosion Preventative Lubricant
- **Product Number:** 12-350
- **National Stock Number (NSN):** 6850-01-328-3617

Jackscrews on a P-3 aircraft before and after the application of Super Corr.

Benfer wanted to see if any other Navy program had experience with Super Corr so he performed a search of the Aircraft Cleaning and Corrosion Control manual (NA 01-1A-509) by entering the relevant military specification (mil-spec) into the Hazardous Material Authorized Use List (HMAUL) Analysis Tool (HAT). He found no incidence of Super Corr (under mil-spec: MIL-L-87177A). So he knew he needed to conduct his own testing to validate the use of the product on P-3 screwjacks.

In Search of A BETTER LUBRICANT

- **December 2000:** Naval message issued requesting support to validate a DSX product as a suitable substitute to VV-L-800.
- **February 2001:** Jacksonville Materials Laboratory issues initial testing report that invalidates DSX product as a suitable substitute to VV-L-800.
- **May 2001:** Jacksonville Materials Laboratory issues second report recommending Super Corr as a potential substitute to VV-L-800.
- **February 2002:** Local P-3 squadron (FST-4) at NADEP Jacksonville begins six-month field demonstration and validation of Super Corr for use on P-3 flap tracks and screwjacks.
- **September 2002:** Field demonstration at NADEP Jacksonville is complete. VP-30 adopts Super Corr as its standard lubricant for P-3 flap tracks and screwjacks.

Benfer called the manufacturer of the recommended lubricant (Lektro-Tech Inc.), received some samples days later and initiated a second round of testing.

Phase 2: Comparing Super Corr to the Existing Lubricant

In the spring of 2002, Benfer and his colleagues conducted a second round of testing using a salt fog chamber with the existing product (VV-L-800), the standard for corrosion protection (MIL-C-81309), and Super Corr.

Benfer ran the salt fog test for seven days (until corrosion appeared on the test coupons). This test validated that Super Corr would, in fact, exceed the corrosion control requirements of VV-L-800. The results of this second round of testing, issued in a Materials Laboratory Report in May 2002, demonstrated that MIL-L-87177A could serve as a potential alternative to VV-L-800.

FIGURE 2: A second round of tests determined that the lubricating and corrosion protection properties of Super Corr were superior to the product being used by the P-3 squadron at NADEP Jacksonville.

The Materials Laboratory did not perform any new lubricating tests on Super Corr but relied instead on lubricity testing already conducted and contained in the scientific literature (in accordance with the ASTM D2266 Standard Test Method for Measurement of Wear Preventive Characteristic of Lubricating Grease (Four-Ball Method).

So the demonstration and validation of the Super Corr lubricant could begin at the local P-3 squadron.

Phase 3: Demonstration and Validation (Beginning February 2002)

Over the course of a six-month demonstration period, starting in February 2002, Martin from the FST (P-3 FST-4) and the local P-3 squadron (VP-30) applied Super Corr to an aircraft through numerous rinses and regularly scheduled washes. Martin was instrumental in keeping this issue on the front burner from laboratory testing through field-testing. Martin made sure that the field-testing continued to validate laboratory data for program implementation.

During this demonstration period, Martin slowly extended application times. At the end of the demonstration period, Martin and Benfer were able to validate the application time (of 28 days) and observed no corrosion or buildup of the product on the screwjacks.

Jackscrews and flap tracks on a P-3 aircraft.

"It was important to go the distance to find a solution that met the Fleet's needs."

During this demonstration period, VP-30 maintenance personnel were able to test the product on other exposed carbon steel components of the landing gear. Some of these components included hydraulic fitting "B-nuts" that have a tendency to corrode. (Note: A "B-nut" is used to attach a hydraulic line to a fitting or junction.) No visible corrosion was evident on these components after 56 days. Super Corr was also applied to bare metal surfaces that required repainting. AM1 William Hawes of VP 30 said, "The ease of application and time required between applications make this product better than any other lubricant I have ever used. This product ranks high in my books."

The P-3 squadron had found it necessary to apply VV-L-800 daily. During the course of the demonstration period, the squadron only needed to apply Super Corr once every 28 days (in line with the regular aircraft wash cycle). The average time per application of VV-L-800 or Super Corr (MIL-L-87177A) is approximately one-half hour per aircraft. If the flap tracks, actuators and jack screws of the 265 aircraft in the P-3 fleet are lubed once every 28 days versus daily, the resultant avoidance can approach more than 46,000 man hours per year.

P-3 Orion Aircraft.

These values address use in the P-3 fleet only. The quantity of Super Corr used per application was consistent with the quantity of VV-L-800. Material consumption is reduced from seven (7) cans of VV-L-800 per aircraft per 28 days, to a quarter of a can of Super Corr per aircraft every 28 days. Although the cost of one can of Super Corr is seven times that of VV-L-800, the Fleet-wide annual material savings could reach more than $32,000. As the aircraft go through scheduled maintenance cycles and modifications, the percentage of aircraft actively flying at one time is reduced. Even at 80 percent, the manhours saved and material costs are still very significant. And these savings take on even greater significance once they are extrapolated across the Fleet.

Rolling Out Super Corr to Other Facilities, Other Aircraft Programs

Along with the successful demonstration at the P-3 squadron at NADEP Jacksonville, James Whitfield and his colleagues at the Materials Laboratory at NADEP Cherry Point, North Carolina tested Super Corr on a resident C-130 squadron. Preliminary results indicate this product provided much longer corrosion protection than the conventional material (VV-L-800), perhaps allowing for the extension of reapplication from one-day intervals to 35 days. Chris Lupton, the lead C-130 engineer at Cherry Point, remarked, "We have been very pleased with the results of applying MIL-L-87177A on the Navy and Marine Corps C-130's flap tracks. The use of MIL-L-87177A

IMPACT ON READINESS

Sailor Workload

- Easier to apply.
- Time between applications is longer (28 days versus daily).
- Less hazardous material is stocked and issued.
- Fewer empty aerosol containers are processed.

Chemical Costs

- Less lubricant is procured.
- Fewer empty aerosol containers are generated.

Asset Availability

- Corrosion protection is improved.
- Manhours can be redirected to priority operational tasks.

AM1 Brian Keppers of VP-30 lubricates jackscrews and flap tracks on a P-3 aircraft.

has reduced scheduled and unscheduled maintenance on the flap tracks by preventing corrosion."

Costs In Line With Performance

Not only does the MIL-L-87177 protect the P-3 Jackscrews better than the existing CIL products, there are also associated labor and material savings.

According to the initial data provided by the test and validation teams, there will be a labor avoidance of close to 30,000 manhours across the P-3 fleet on a yearly basis. In addition, material savings of approximately $22,000 are expected once the new product is adopted. While the labor savings will not translate directly back to cost savings, they are hours that can be redirected to other critical areas on the P-3 aircraft. The AAIPT-CFFT will work to verify the results once they are available in about a year.

Implications For the Fleet

Since the use of VV-L-800 is not limited to the P-3 VP-30 squadron at NADEP Jacksonville, it is interesting to consider the potential impact of substituting Super Corr for VV-L-800 across the entire Fleet.

According to data available from the Environmental Systems Allocation (ESA) database, there are fifteen field activities that reported using VV-L-800 for at least one calendar year from Calendar Year (CY) 1999 through CY 2001. (The following field activities reported VV-L-800 use in calendar years 1999, 2000 and 2001: Marine Corps Air Station (MCAS) Cherry Point, MCAS Miramar, MCAS Yuma, Marine Corps Base (MCB) Camp Pendleton, MCB Hawaii, NADEP Cherry Point, NADEP Jacksonville, NADEP North Island, Naval Air Station (NAS) Jacksonville, NAS Kingsville, NAS Lemoore, NAS Meridian, NAS North Island, NAS Oceana, and NAS Whidbey Island.)

Examining the material use at the Operational, Intermediate and Depot levels of maintenance reported to ESA reveals an annual use exceeding 30,000 pounds in CY99 and CY01. Use of VV-L-800 reached a peak of over 60,000 in CY00 (due to the arrival of a C-130 squadron at NADEP Cherry Point).

The field activities reporting to ESA account for 48 percent of the naval aviation aircraft inventory. Conversely, 52 percent of the inventory is not represented in ESA. It is reasonable to assume, therefore, that there is more VV-L-800 used during standard Naval aviation maintenance procedures at other field activities (in addition to those reporting to ESA).

The potential benefits of substituting Super Corr for VV-L-800 across the Fleet are the greatest among the field activities and programs that use the most VV-L-800. In addition, the number of references to VV-L-800 in the various General Series and Type/Model Series manuals is also an indicator of the amount of VV-L-800 used.

VV-L-800 References In General and Type/Model Series Manuals

In addition to the use of VV-L-800 at various field activities and platforms as reported in ESA, an electronic search of references to VV-L-800 was conducted on over 8000 manuals using the HMAUL Analysis Tool or HAT. In its current configuration, HAT contains 8,108 manuals. The Naval Air Systems Command (NAVAIR) has approximately 20,500 active maintenance manuals. Inclusion rates in HAT vary by program and are

What Else Needs TO BE DONE

Sailors

- Review platform VV-L-800 requirements.
- Generate manual change requests.
- Discuss potential manual changes with Fleet Support Team leader.

Fleet Support Teams & Program Staff

- Obtain engineering field data from NADEP Jacksonville Materials Laboratory.
- Issue Interim Rapid Action Changes (IRAC) where appropriate.
- Incorporate substitute for VV-L-800 into regular manual update cycle.
- Contact HAT manager (Eric Rasmussen) for exact page references to support manual reviews.

Environmental Managers & Material Handlers

- Review VV-L-800 use at field activities.
- Communicate potential benefits of VV-L-800 substitution to sailors and marines.
- Support authorization and use of substitute material (Super Corr) once manual changes are complete.

rising rapidly. (For additional information about the HAT and/or NAVAIR's maintenance manuals, contact Eric Rasmussen (732-323-7481 or eric.rasmussen@navy.mil), Ebbie Crockett (619-545-2010 or CrockettE@navair.navy.mil) or Margaret Anderson (805-982-3008 or AndersonMJ@nfesc.navy.mil).

The results of the HAT search for VV-L-800 show that 41 programs, 274 manuals, and 1,622 pages in the manuals reference the use of VV-L-800. The analysis provides both the maintenance directives requiring the use of VV-L-800 and opportunities to further investigate a Super Corr substitution across multiple NAVAIR platforms.

Summary

Initial results are promising. Substituting Super Corr for VV-L-800 at NADEP Jacksonville demonstrated benefits in material costs, labor savings, and waste reductions. These benefits can be further realized across the Fleet as Super Corr is considered as a substitute for VV-L-800 on other platforms at additional field activities. The research and analysis conducted by the Materials Laboratory at NADEP Jacksonville is further documented through searches of the Environmental Systems Allocation database and the HMAUL Analysis Tool.

VV-L-800 Across the Fleet: References In General and Type/Model Series Manuals & Recorded Usage Levels

Program or Product Line	Manuals That Contain VV-L-800 References	No. Pages That Contain VV-L-800 References	Recorded VV-L-800 Use
P-3	22	378	HIGH
EA6B	12	120	HIGH
FA-18ABCD	21	108	MEDIUM
F-14	7	73	HIGH
General Series	12	71	—
H-53	15	71	MEDIUM
CSE	17	70	MEDIUM
E2C	13	67	LOW
S-3	8	59	MEDIUM
AV8B	13	52	HIGH
H-1	15	50	LOW
Guns	9	41	—
FA-18EF	7	38	—
H-3	7	36	LOW
Mobile Equipment	14	36	—
H-60	5	32	HIGH
H-46	5	30	MEDIUM
Accessories	3	28	—
C-2	5	26	LOW
E-6	5	25	—
T-2	2	24	—
Bomb Racks	6	22	—
T-45	4	22	LOW
Survival	5	18	—
Missiles	6	15	LOW
ALRE	2	14	—
Ordnance	2	13	—
AMCM	2	12	—
F-14D	5	12	—
A-4	2	10	—
C-9	1	9	LOW
C-130	6	7	HIGH
F-402	3	7	—
UAV	4	7	—
T-56	2	4	—
Engines	2	3	—
F-110	1	3	—
T-39	1	3	—
V-22	1	3	LOW
NSTM	1	2	—
Launchers	1	1	—
TOTALS	274	1,622	

The recorded usage levels contained in this table were extracted from the ESA database for the calendar years 1999, 2000 and 2001.

A search was performed for mil-spec MIL-PRF-32033 (VV-L-800 (Lubricating Oil, General Purpose, Preservative, (Water-Displacing, Low Temperature)).

A value of "—" means that no data were collected and/or available via ESA.)

HIGH = 3,001 pounds or greater used
MEDIUM = 1,001 to 3,000 pounds used
LOW = 0 to 1,000 pounds used

A U.S. Customs Service P-3 going its 28-day wash at the wash rack in Jacksonville. Notice the powerful water stream used to remove contaminants from the skin and exposed components.

"It wasn't enough to stop once the requirements outlined in the original naval message were met."

The Naval Air Technical Data and Engineering Service Command (NATEC) is generating an IRAC to the Aircraft Weapons Systems Cleaning and Corrosion Control Manual (NA 01-1A-509) to replace VV-L-800 with Super Corr. (More information about this IRAC can be obtained from Ebbie Crockett, NATEC.)

Over the next several months, the P-3 FST-4 and personnel from the Materials Laboratories at NADEP Jacksonville and NADEP Cherry Point will expand the use of Super Corr to avionics equipment including electrical connectors (especially aboard the P-3) and electrical push switches contained in EA-6B gearboxes.

Benfer and his colleagues have also approached personnel from NADEP Jacksonville's Avionics Department to test the application of Super Corr to countermeasure devices. Based on the encouraging results of the initial tests, the electronics engineers are already moving forward to apply Super Corr to countermeasure devices and track their own experiences with the product.

Benfer and Whitfield, in their capacity as members of the Aging Aircraft Integrated Product Team Corrosion Fleet Focus Team (AAIPT-CFFT), are hoping to incorporate the use of Super Corr into the maintenance regimes of other platforms (beyond the P-3 and C-130). In addition to cross platform transition through continued validation, the AAIPT-CFFT is also working with the Cognizant Field Activity (CFA) of the Aircraft Cleaning and Corrosion Control manual (NA 01-1A-509) to have Super Corr added as an approved corrosion preventative product.

This substitution demonstrates how an environmental objective (finding a safer, corrosion preventive lubricant) and be achieved in concert with a corresponding operational readiness objective (getting the job done faster and better).

Rolling out Super Corr to other platforms across the Fleet and working to incorporate the product in the Aircraft Cleaning and Corrosion Control manual shows how the NADEP Jacksonville engineering team is going the distance for the Fleet. ⚓

Another Reformulation of SUPER CORR

Super Corr may need to be reformulated to eliminate 1,1-dichloro 1-fluorethane (1717-00-6), a hydro-chloro-fluorocarbon (HCFC) that may be prohibited for use by the U.S. Environmental Protection Agency.

Previous formulations of Super Corr had used Freon as a propellant that allowed the product to be atomized (sprayed). The product was reformulated with the above-referenced HCFC as a substitute for the Freon. There is some risk that at some future date, Super Corr will need to be reformulated once again to eliminate this HCFC.

CONTACTS

Jack Benfer
Materials Laboratory
Naval Air Depot Jacksonville
904-542-4516, x-153
DSN: 942-4516, x-153
BenferJE@navair.navy.mil

Karl Martin
Fleet Support Team (P-3 FST-4)
904-542-0514, x-115
DSN: 942-0514, x-115
MartinKM@navair.navy.mil

Dave Brock
Lead Maintenance Technology
Center for the Environment
904-542-0516, x-122
DSN: 942-0516, x-122
BrockDL@navair.navy.mil